



**Barcelona  
Supercomputing  
Center**  
*Centro Nacional de Supercomputación*



# El proyecto SPECS y la multidisciplinaridad en la investigación en servicios climáticos

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## What

Environmental forecasting

... research ...  
... operations ...  
... services ...  
... high resolution ...

## How

Develop a capability to model air quality processes from urban to global and the impacts on weather, health and ecosystems

Implement climate prediction system for subseasonal-to-decadal climate prediction

Develop user-oriented services that favour both technology transfer and adaptation

Use cutting-edge HPC and Big Data technologies for the efficiency and user-friendliness of Earth system models

Earth system  
services

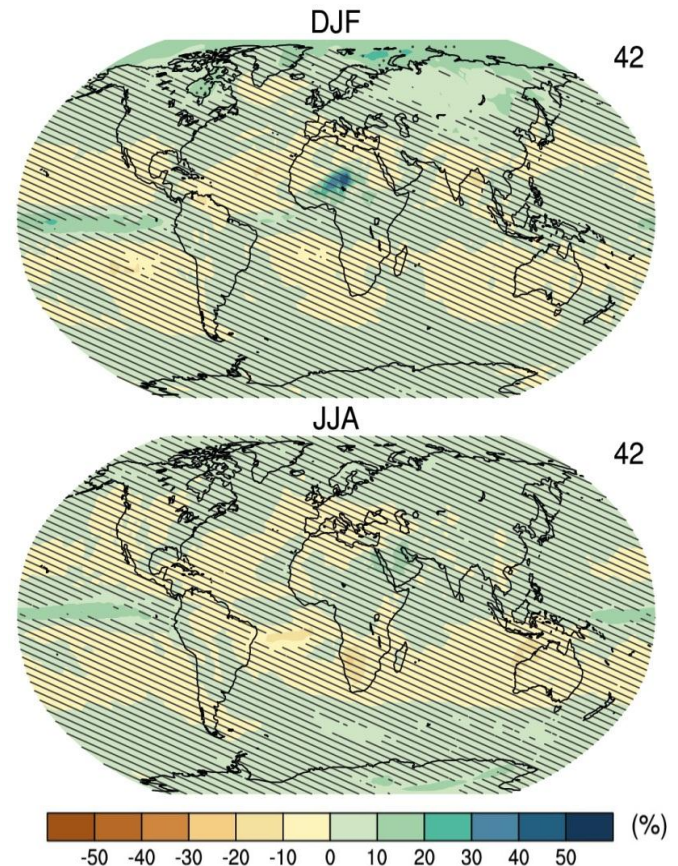
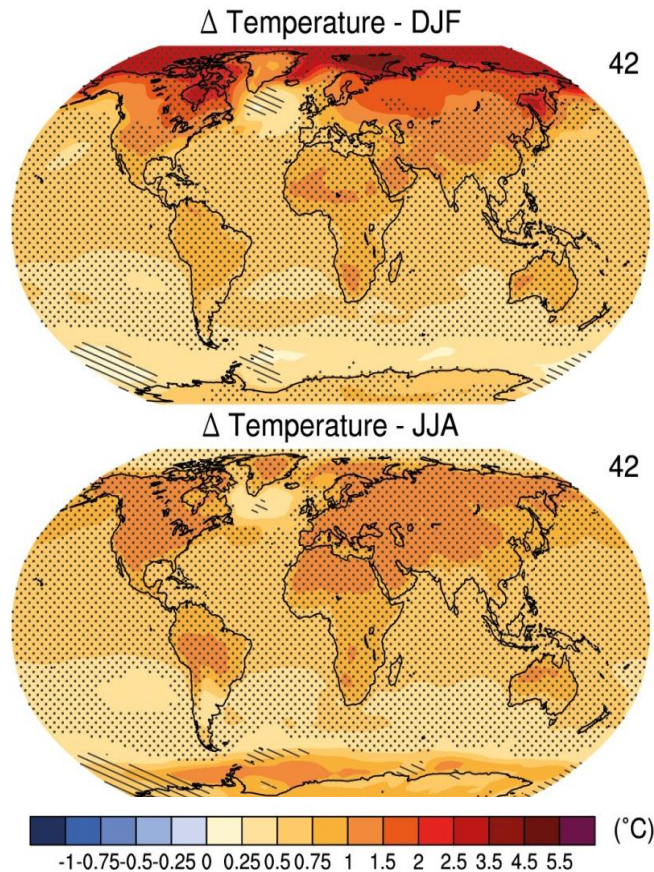
Climate  
prediction

Atmospheric  
composition

Computational  
Earth sciences

# What is coming up for climate?

Seasonal-mean air temperature and percentage precipitation change for the RCP4.5 scenario from CMIP5 over **2016-2035** (wrt 1986-2005). Stippling for significant changes, hatching for non-significant.

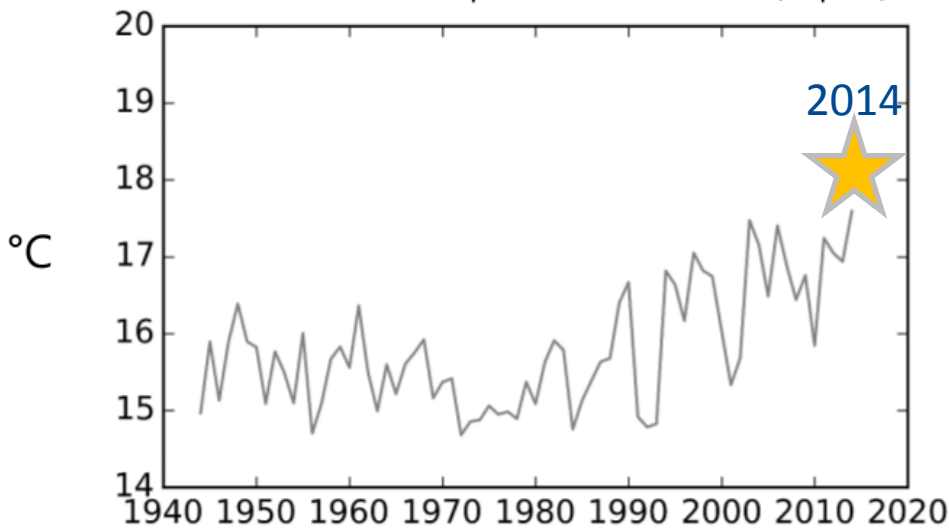


# A local example of what people ask for

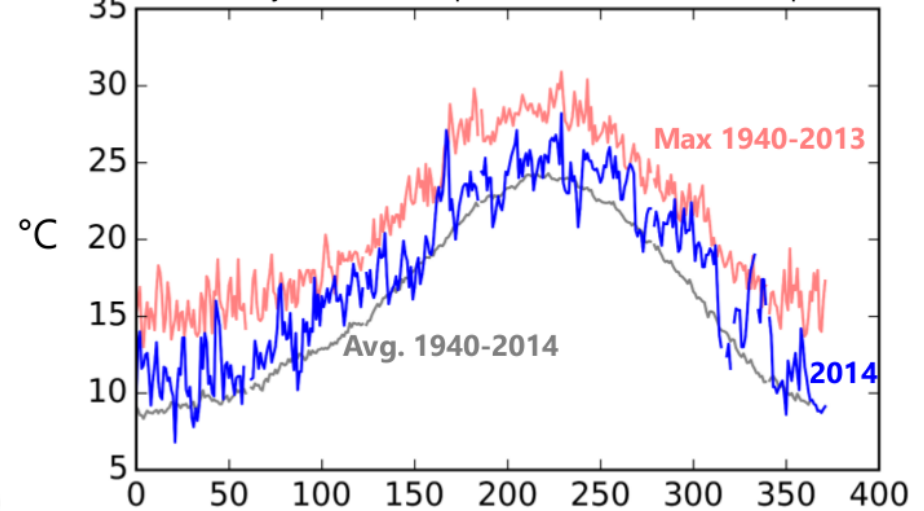


Temperatures in Barcelona airport from the ECAD dataset.

Annual mean air temperatures, Barcelona (airport)



Seasonal cycle of air temperatures in Barcelona (airport)





# A more complex example



Bodegas Torres (a Spanish winery) is looking for new locations for its vineyards (and it's not the only one doing it).

Land is being purchased closer to the Pyrenees, at higher elevation. They are considering acquiring land in South America too, in areas where wine is currently not produced.

Bodegas Torres requests local climate information (including appropriate uncertainty assessments) for the vegetative cycle of the vine, which lasts 30-40 years.

Some users need to make the decision now.



Climate services is just a concept, predictions and projections are just a tool

The Catalan government has requested the climate community the preparation of the Third Report on Climate Change for Catalonia.

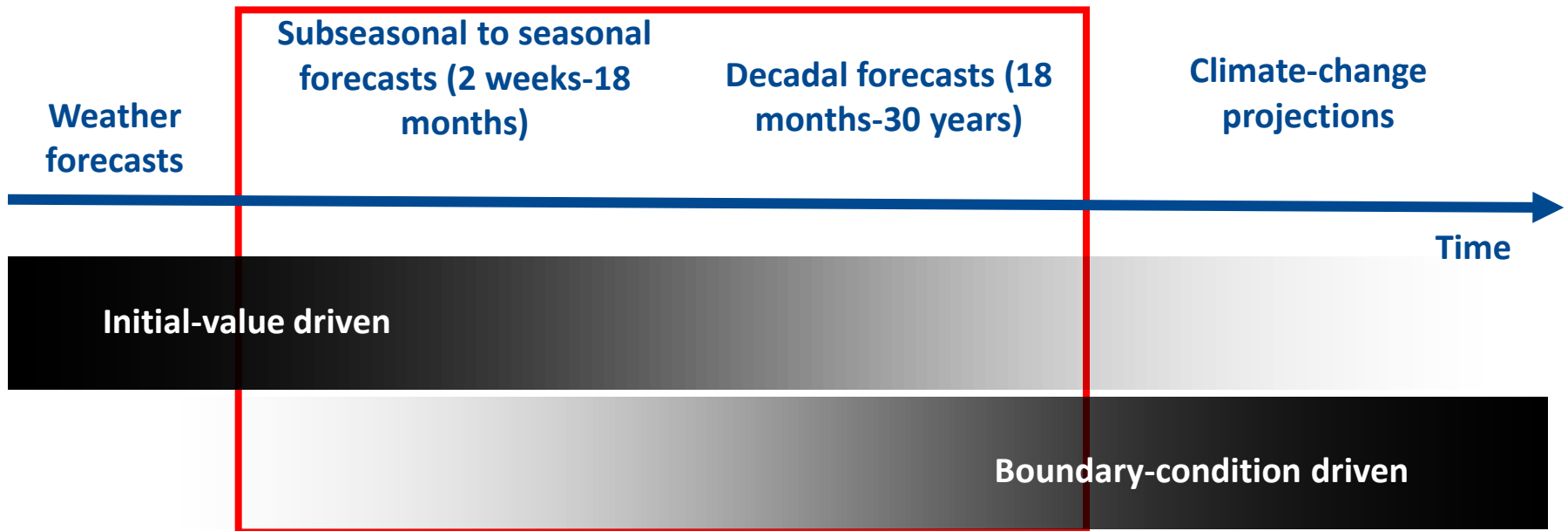
A broad range of socio-economic sectors (including private actors) are involved: agriculture, energy, tourism, ecosystems, etc.

Users requested a focus on 2031-2050, but also 2015-2024.

How should we merge the information from global and regional projections? How to build stories from the short to the mid term?

2031-2050	Winter	Spring	Summer	Autumn	Annual
Litoral	0.6 (0/1.2)	0.7 (0.3/1.1)	0.9 (0.3/1.5)	0.8 (0.3/1.2)	0.8 (0.5/1)
	0.4 (-27/22.4)	-5.7 (-27.9/22.6)	-4.1 (-19.5/20.7)	-7.9 (-26/25.2)	-2.6 (-20.1/5.7)
Interior	0.6 (0/1.1)	0.7 (0.2/1.4)	0.8 (0.4/1.7)	0.9 (0.2/1.2)	0.8 (0.5/1)
	2.5 (-17.6/29.1)	-6.6 (-24.6/24.6)	-3.4 (-21.4/13.9)	-5 (-21.6/25.4)	-0.2 (-14.3/8.3)
Pirineu	0.7 (-0.1/1.2)	0.8 (0.3/1.5)	0.9 (0.5/1.7)	0.9 (0.3/1.3)	0.8 (0.5/1.2)
	2.4 (-13.8/35.3)	0.0 (-22.7/17.4)	-3.3 (-21.2/11.8)	-0.8 (-21.9/18.8)	-1.2 (-8.8/7.8)
Catalunya	0.7 (0/1.2)	0.7 (0.3/1.4)	0.8 (0.4/1.6)	0.8 (0.3/1.2)	0.8 (0.5/1)
	1.0 (-18.7/19.8)	-3.9 (-24.9/17.9)	-4.1 (-19.8/13.8)	-5.4 (-22.9/21.8)	-2.4 (-13.6/5.4)

Progression from initial-value problems with weather forecasting at one end and multi-decadal to century projections as a forced boundary condition problem at the other, with climate prediction (**sub-seasonal, seasonal and decadal**) in the middle. Prediction involves initialization and systematic comparison with a **simultaneous** reference.

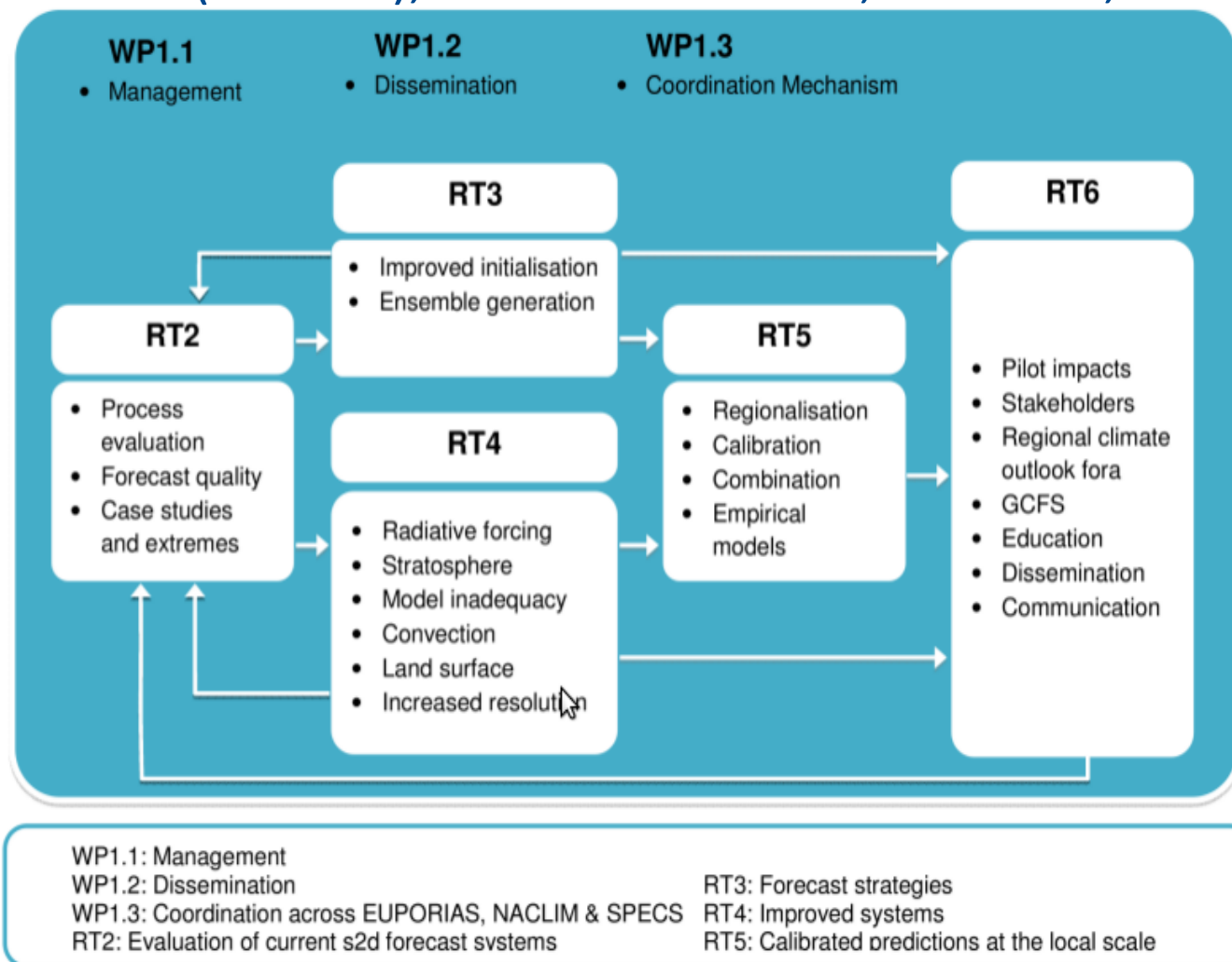


Adapted from Meehl et al. (2009)

Nine million euros, four years, 20 partners.

Links to EUPORIAS/NACLIM (**ECOMS**), but also IS-ENES2, PREFACE, EUCLEIA, CLIPC, ...

Forecast System	Project Partners
CNRM-CM5	CNRM, CERFACS
EC-Earth	KNMI, SMHI, IC3, ENEA
IFS/NEMO	ECMWF, UOXF
IPSL-CM5	CNRS
MPI-ESM	MPG, UniHH
UM	UKMET





Successful Climate Service Principles

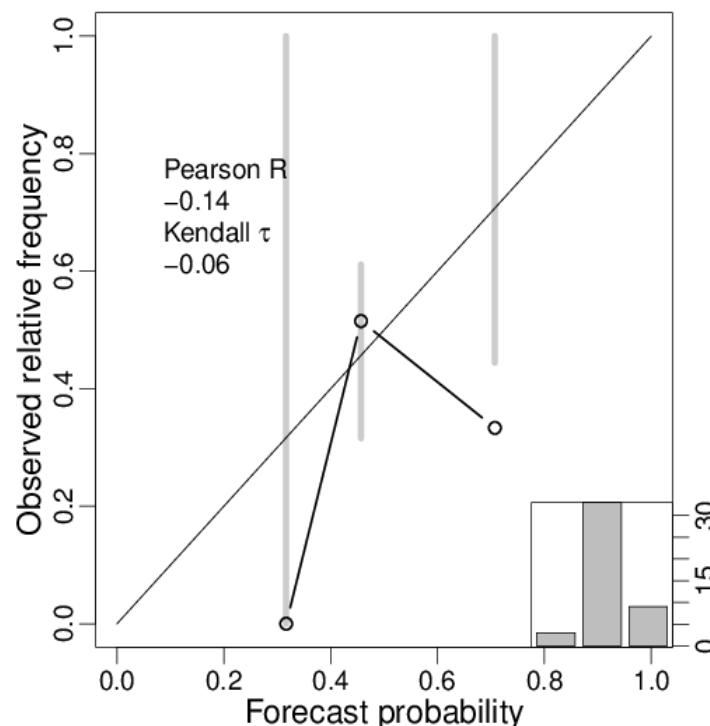
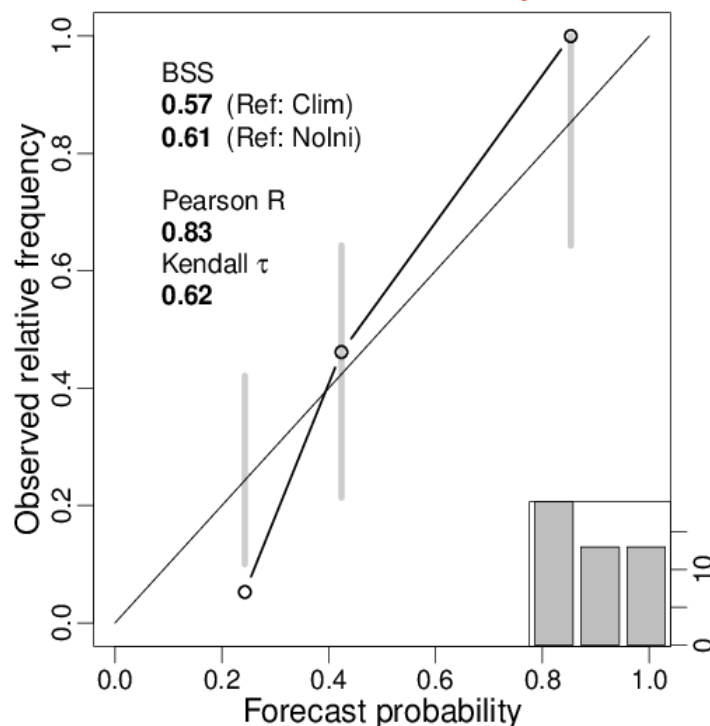
Climate data is not climate information

- 1 Who What Why How  
Understand the USER CHAIN
- 2 Involve the appropriate ACTORS.  
KNOWLEDGE, EXPERIENCE &  
EXPERTISE needed to jointly design,  
deliver & operate a  
climate service
- 3 LISTEN to your USER & take  
time to ensure you have  
a SHARED UNDERSTANDING  
(of the scope)
- 4 IDENTIFY the potential TENSION'S  
that could prevent the development  
of the service.  
BUILD TRUST THROUGH  
TRANSPARENT  
communication of your own assumptions  
& expectations (both provider & user)
- 5 AGREE THE  
SCOPE based on  
expected ADDED  
VALUE.
- 6 KEEP THE SERVICE  
SHARP THROUGH  
ITERATIVE  
IMPROVEMENT  
ENSURE THE BENEFIT  
& CHALLENGES are  
jointly identified
- 7 Monitor & Evaluate

EUPORIAS

Reliability diagrams of left) initialised and right) uninitialised MME simulations for basin-wide **accumulated cyclone energy** (ACE). The results are for 2-9 year averages above the climatological median over 1961-2009. Statistically significant values are in bold.

Some of the added value of the predictions is their better management of uncertainty, which leads to increased **credibility**.



The multi-model real-time decadal prediction exchange is a research exercise that guarantees equal ownership to the contributors.

WMO-CCI plans to sponsor this activity.

<http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/long-range/decadal-multimodel>

## Multi-model decadal forecast exchange

The Met Office coordinates an informal exchange of near-real time decadal predictions. Many institutions around the world are developing decadal prediction capability and this informal exchange is intended to facilitate research and collaboration on the topic.

[The contributing prediction systems](#) are a mixture of dynamical and statistical methods. The prediction from each institute is shown below, alongside an average of all the models. When possible, observations for the period of the forecast are also shown. Currently three variables are included: surface air temperature, sea-level pressure and precipitation. These are shown as differences from the 1971-2000 baseline. More diagnostics, including ocean variables are planned for the future. Please use the drop-down menus below to explore the data collected to date.

This work is supported by the European Commission SPECS project.



To learn more about decadal forecasts at the Met Office, see our current [decadal forecast](#).

Images last updated 2014-06-25

Issued

2013

Period

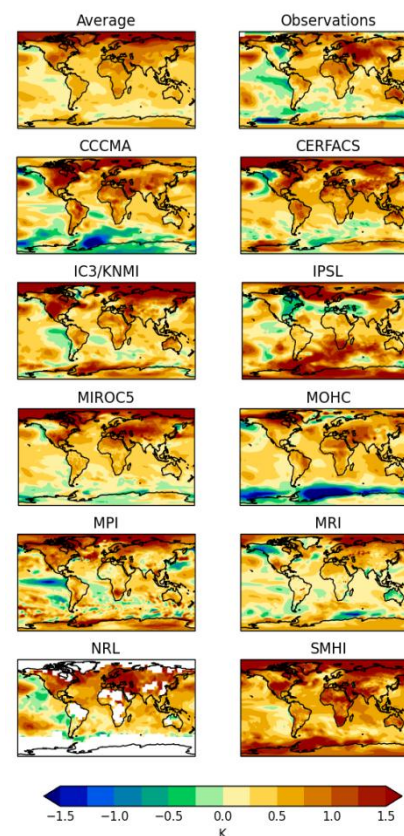
year 1

Element

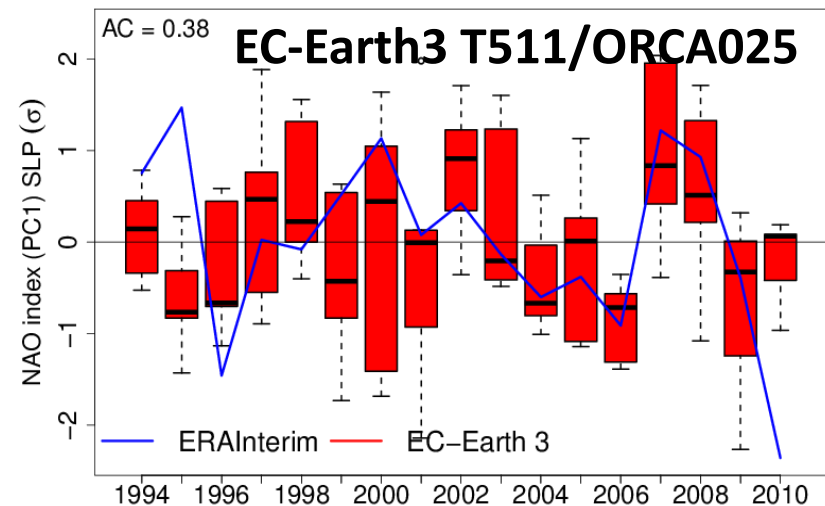
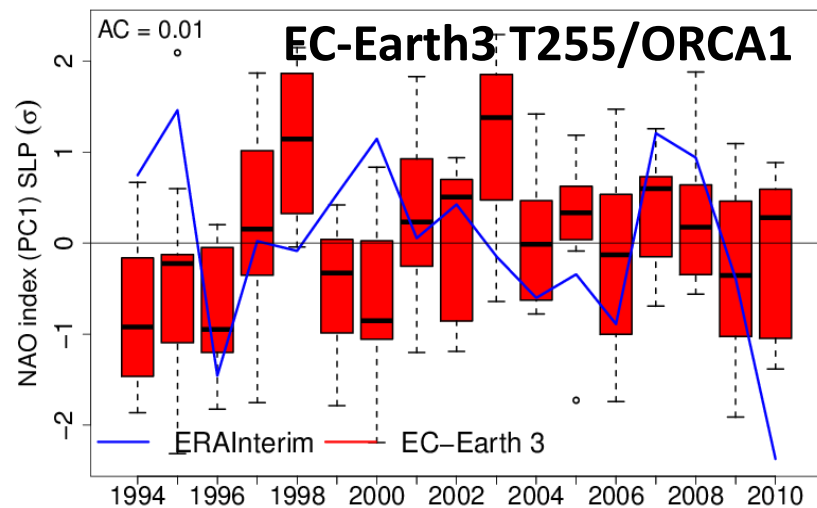
surface air temperature

Decadal forecast exchange 2013 predictions for year 1 surface air temperature

2012 predictions for 2013 surface temperature



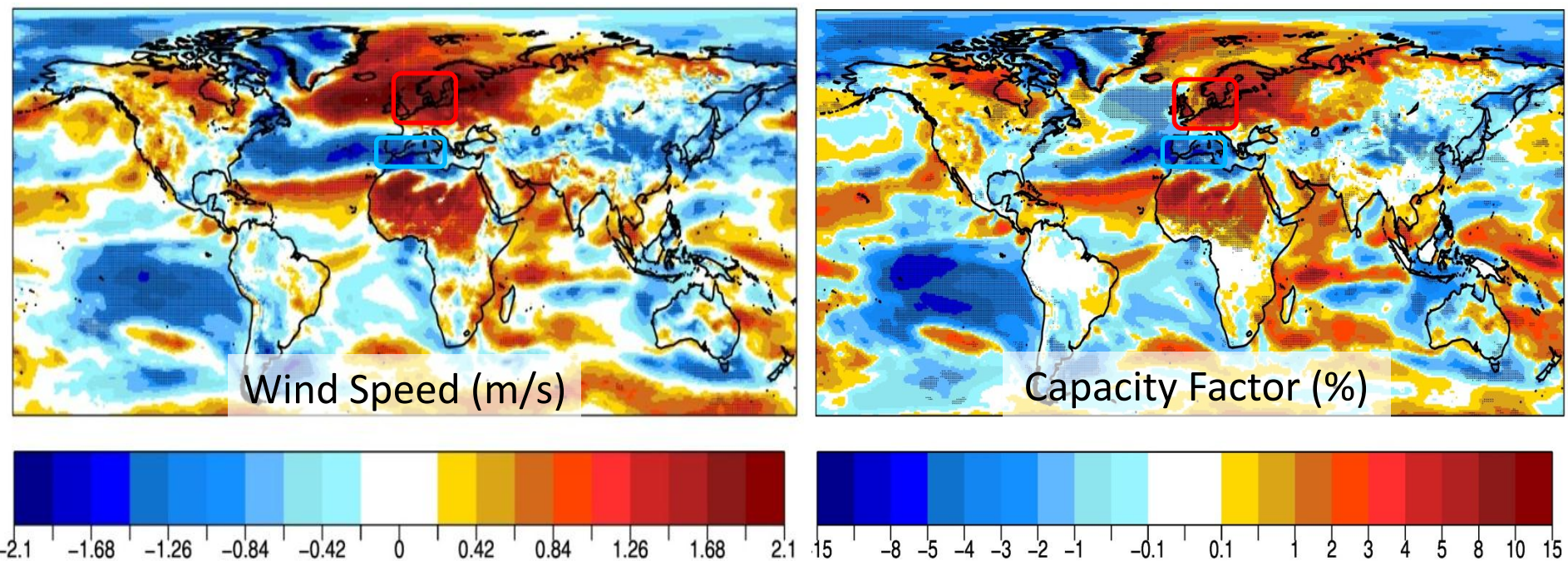
Predictions of DJF NAO with EC-Earth3 at low and high resolution started in November over 1993-2009 with ERA-Interim and GLORYS initial conditions and five-member ensembles. Correlation of the ensemble mean on top left.



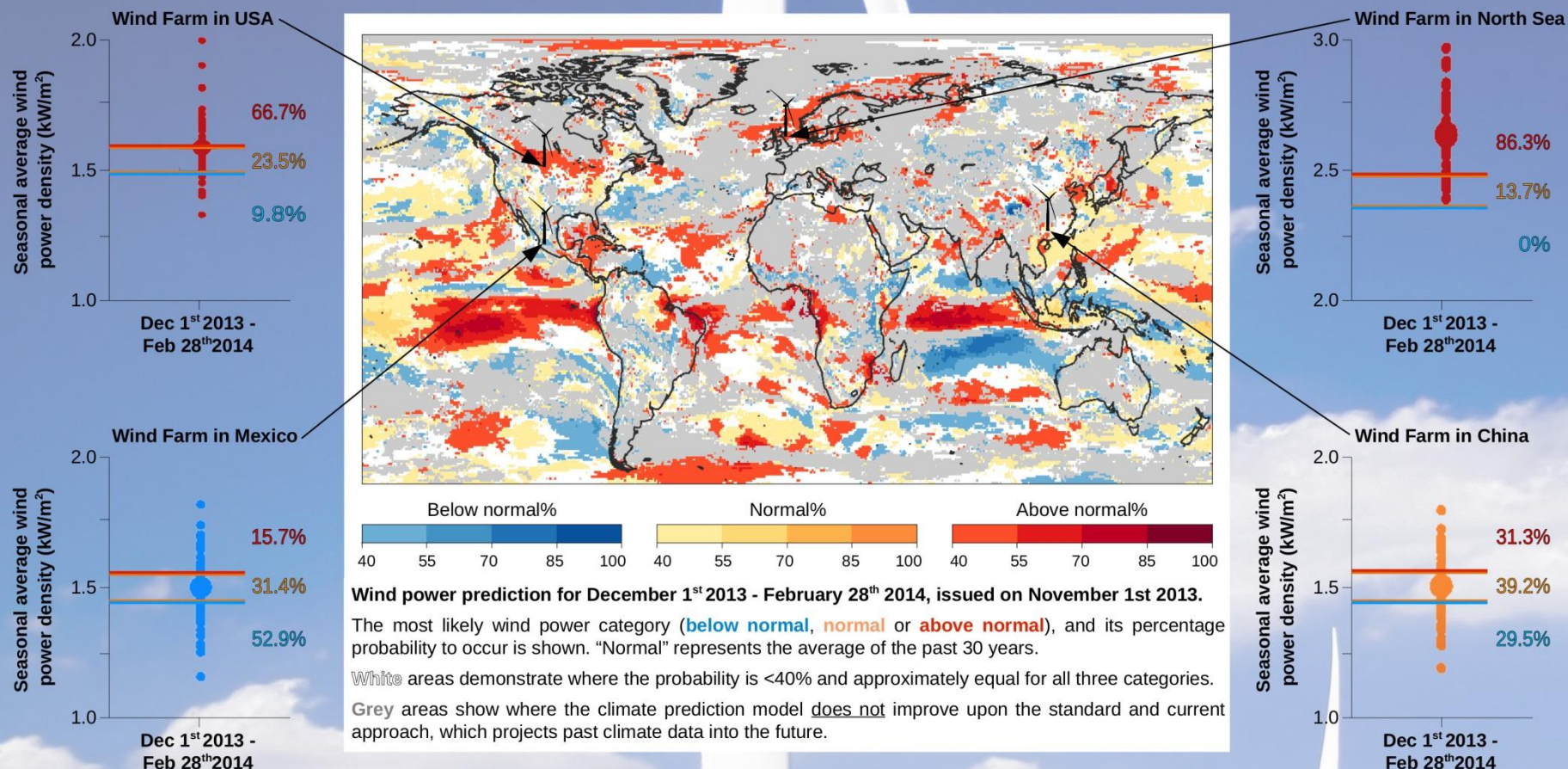


Difference in winter (DJF) standardised 10-metre wind speed (left) and capacity factor (right) for seasons with above normal and below normal North Atlantic Oscillation index.

Daily capacity factor (%) calculated from ERAInterim 10-metre wind speed and temperature data using an idealised power curve, a log scaling law to transform the wind to hub height wind, and a Rayleigh distribution to model diurnal variability.



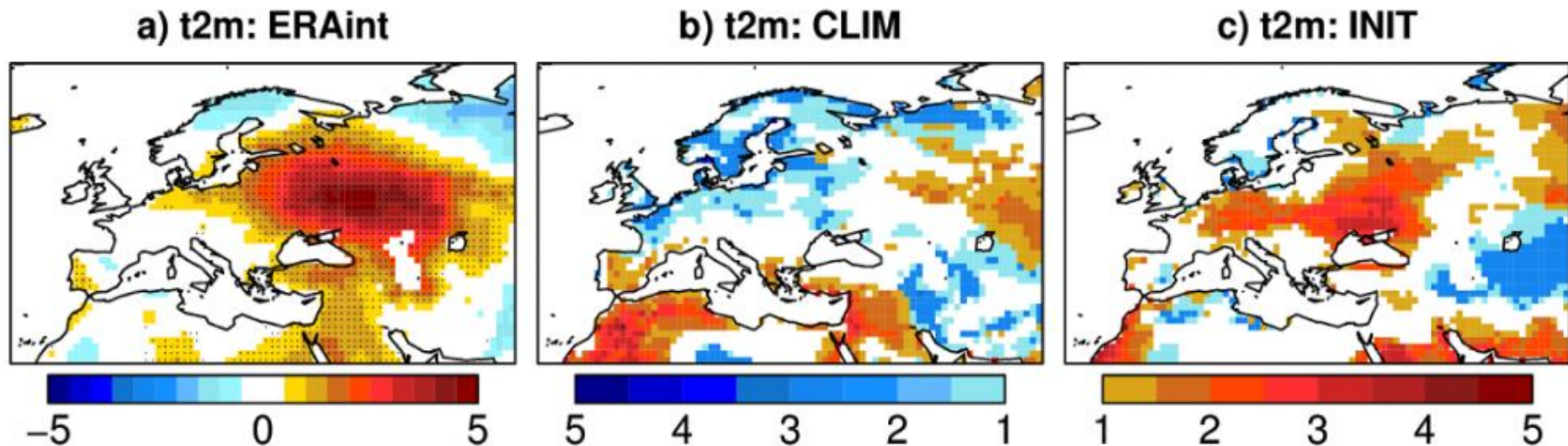
## Illustrative examples of seasonal wind power predictions





JJA near-surface temperature anomalies in 2010 from ERAInt (left) and experiments with a climatological (centre) and a realistic (right) land-surface initialisation.

Results for EC-Earth2.3 started in May with initial conditions from ERAInt, ORAS4 and a sea-ice reconstruction over 1979-2010.

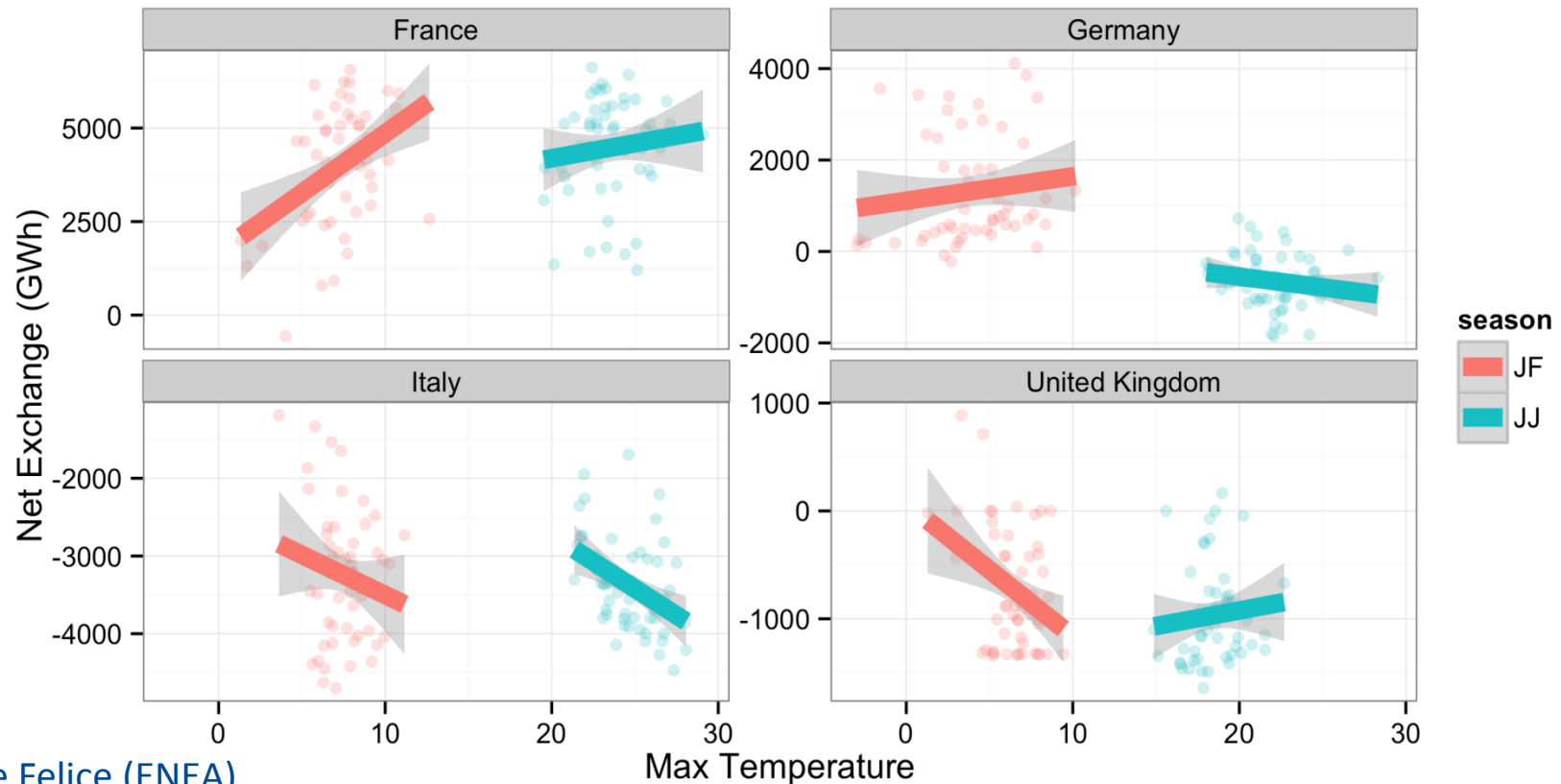


# Temperature forecasts for energy



Weather and climate affect exchanges via electricity demand (heating or cooling, from the customer point of view) and RE production.

Data from ENTSO-E (2003-2014).





A series of fact sheets has been started (available from the SPECS web site). Common vocabulary with EUPORIAS, targeting a wide audience, mimicking some material already existing to explain what climate change is.


SPECS Fact sheet #2

What is a decadal prediction?

October 2014

Weather is chaotic which limits its predictability to one or two weeks. This means that it will never be possible to extend normal weather forecasts to seasonal time-scales and beyond.

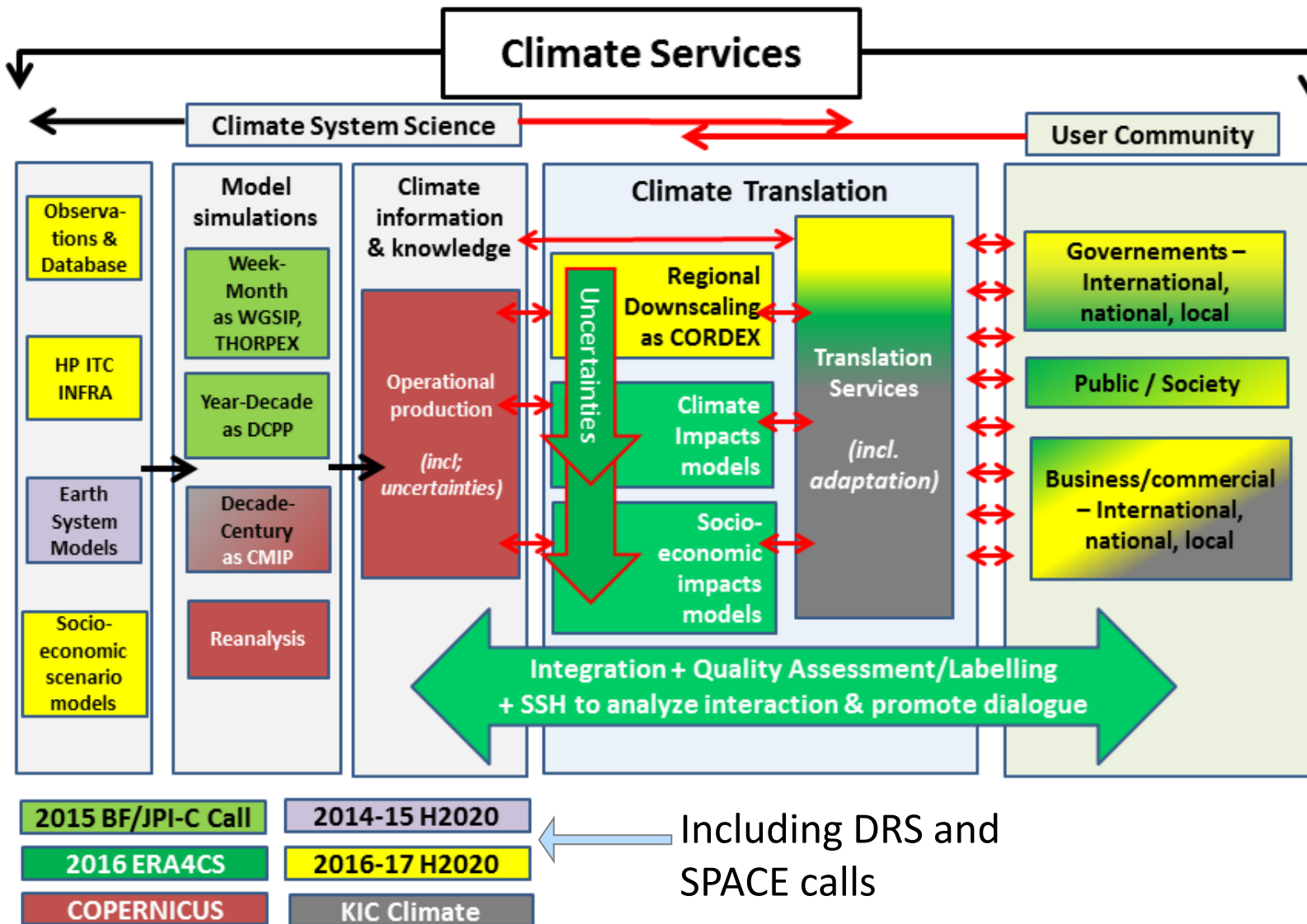
For example, we will never be able to predict the weather on a specific date in a specific place years in advance. However, **changes in prevailing weather over the course of several months to years are potentially predictable**. For instance we may be able to say if a particular region might expect, on average, colder winters or drier summers. Such changes in weather patterns occur due to the interaction of the atmosphere with more slowly varying parts of the Earth system.



Weather is a result of energy moving through the Earth system. Energy is originally radiated to the Earth from the Sun, with most being re-emitted or reflected back to space. The amount that remains in the Earth system is modulated by many things: some emerge naturally within the system (*internal variability*), whilst others are controlled by external factors such as variations in solar output, greenhouse gases, and atmospheric particles

# What's coming up

## The EC view of the beast.



- Requests for climate information for the next 30 years as a continuous stream come from a **broadening range of users** and should be addressed from a climate services perspective.
- **Different tools** available: global and regional projections, seasonal and decadal predictions, empirical systems, etc. **Merging all the sources** into a reliable, unique solution is still an open problem.
- SPECS and the set of pioneer climate-services projects have opened the way, but much more work is needed, with **public-private cross-fertilization** being mandatory.
- Actors other than the usual suspects should be taken into account: WCRP, Future Earth, “the market”, Copernicus (open data), etc.
- What can be done in Spain? Identify and support a community, be proactive in fora where Spain is not active, ...  
**lobby, lobby and lobby.**